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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO
09/864,376	05/25/2001	Tadahiro Ohmi	107176-00007	1605

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EXAMINER	
ZERVIGON, RUDY	

ART UNIT	PAPER NUMBER
1763	

DATE MAILED: 06/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/864,376	OHMI ET AL.	
	Examiner	Art Unit	
	Rudy Zervigon	1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9,12-14 and 16-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,12-14 and 16-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on March 29, 2004 has been entered.

Claim Rejections - 35 USC § 103

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

3. Claims 1-5, 7, 8, 9, 12, and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (USPat. 5,861,601) in view of Otsubo et al (USPat. 4,985,109). Sato teaches a plasma processing apparatus (Figure 2) including:

i. A processing chamber (3, Figure 2)

ii. A microwave (6, Figure 2) slot radiating antenna / radiating surface (41, Figure 2; column 9, lines 6-30)

iii. A plate-shaped dielectric body (4, Figure 2; column 4, lines 25-35)

iv. A distance "D" between the microwave radiating antenna surface (41, Figure 2; column 9, lines 6-30) and a surface of the dielectric body (4, Figure 2; column 4, lines 25-35) is shown by Sato et al in Figure 2

v. Sato et al teaches a dielectric plate as discussed above

vi. Sato further teaches the plasma (column 3; lines 58-67) is formed between the plasma exciting surface (4; Figure 2 – the lower surface of the dielectric body) and the object (10; Figure 2) to be processed – claim 1

Sato does not teach a specific thickness "d" for his dielectric plate. Sato does not teach a slot antenna where a part of the number of slots is closed. Sato does not teach forming a standing wave microwave between his microwave radiating surface (41; Figure 2) and his plasma exciting surface (4; Figure 2 – the lower surface of the dielectric body). Sato further does not teach relative spacing (Applicant's "D") between Sato's plate-shaped dielectric body (4, Figure 2; column 4, lines 25-35) and Sato's plasma radiating surface (41; Figure 2).

Otsubo teaches a concentric slot antenna (Figure 2) in a microwave plasma reactor (Figure 1) having a number of slots (5a) formed and distributed in the microwave radiating surface where a part of the number of slots can be closed (column 7, lines 3-15). Otsubo further teaches a standing wave (column 19, lines 31-37) microwave between his microwave radiating surface (5; Figure 13) and his plasma exciting surface (4; Figure 13 – the lower surface of the quartz plate) – "...the standing wave of the microwaves is generated between the slot plate 5 and the stage 7 ". Otsubo further teaches identical means (5, 5a, 4; Figures 1,2; column 7, lines 3-15; column 19, lines 31-37) to delimit propagation of Otsubo's standing waves as taught by Applicant's specification (page 19, lines 14-23):

"

That is, for the purpose of forming a favorable standing wave in the region between the lower surface of the radial line slot antenna 6 and the plasma exciting surface to generate a high density plasma in the processing cavity 3, the distance D between the lower surface of the radial line slot

antenna 6 and the lower surface the dielectric plate which represented with the wavelength of the microwave being a distance unit , has only to satisfy the inequality

0.7n/4 ≦D≦1.3n/4 (n being a natural number).

"

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Sato to optimize the thickness of the dielectric plate, and for Sato to use Otsubo's slot antenna during standing wave microwave propagation.

Motivation for Sato to optimize the thickness of the dielectric plate is for optimizing the space "between the slot antenna and the quartz window 4 through which the microwaves pass so that the microwaves emitted from the slot antenna have room to expand" (column 9, lines 6-30) as taught by Otsubo, further, motivation for Sato to use Otsubo's slot antenna under standing wave microwave propagation is for "easy" plasma generation as taught by Otsubo (column 19, lines 35-40).

4. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (USPat. 5,861,601) and Otsubo et al (USPat. 4,985,109) in view of Tsuchihashi, Masaaki et al (USPat. 6,109,208). Sato and Otsubo are discussed above. Sato and Otsubo do not teach plural slots of the microwave radiating antenna where the plural slots in the peripheral direction are closed. Tsuchihashi teaches a similar microwave plasma generating device (Figure 20, 21; column 11, lines 37-49) including plural slots ("slits" 6a-d, 10a-d) in the peripheral direction of the shutter antenna (26) where portions of the slots ("slits" 6a-d) in the peripheral direction can be opened ("A" direction; Figure 20) or closed (counter to "A" direction; Figure 20).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace Sato and Otsubo's microwave radiating antenna with Tsuchihashi's shutter antenna where portions of the slots in the peripheral direction can be opened or closed as taught by Tsuchihashi, and for Sato to optimize the thickness of the dielectric plate.

Motivation to replace Sato and Otsubo's microwave radiating antenna with Tsuchihashi's shutter antenna where portions of the slots in the peripheral direction can be opened or closed as taught by Tsuchihashi is for distributing microwaves as taught by Tsuchihashi (column 11, lines 37-49), further, motivation for Sato to optimize the thickness of the dielectric plate is for optimizing the space "between the slot antenna and the quartz window 4 through which the microwaves pass so that the microwaves emitted from the slot antenna have room to expand" (column 9, lines 6-30)

5. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (USPat. 5,861,601) and Otsubo et al (USPat. 4,985,109) in view of Tsuchihashi, Masaaki et al (USPat. 6,109,208). Sato and Otsubo are discussed above. Sato and Otsubo do not teach plural slots of the microwave radiating antenna where the plural slots in the peripheral direction are closed.

Tsuchihashi teaches a similar microwave plasma generating device (Figure 20, 21; column 11, lines 37-49) including plural slots ("slits" 6a-d, 10a-d) in the peripheral direction of the shutter antenna (26) where portions of the slots ("slits" 6a-d) in the peripheral direction can be opened ("A" direction; Figure 20) or closed (counter to "A" direction; Figure 20).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace Sato and Otsubo's microwave radiating antenna with Tsuchihashi's shutter antenna where portions of the slots in the peripheral direction can be opened or closed as taught by Tsuchihashi.

Motivation to replace Sato and Otsubo's microwave radiating antenna with Tsuchihashi's shutter antenna where portions of the slots in the peripheral direction can be opened or closed as taught by Tsuchihashi is for distributing microwaves as taught by Tsuchihashi (column 11, lines 37-49).

6. Claims 16-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sato et al (USPat. 5,861,601) in view of Otsubo et al (USPat. 4,985,109). Sato is discussed above. Sato further teaches a plasma processing apparatus (Figure 2) including a microwave (6, Figure 2) radial line (41; Figure 3) slot radiating antenna / radiating surface (41, Figure 2; column 9, lines 6-30)

Sato does not teach a specific thickness "d" for his dielectric plate. Sato does not teach a slot antenna where a part of the number of slots is closed. Sato does not teach forming a standing wave microwave between his microwave radiating surface (41; Figure 2) and his plasma exciting surface (4; Figure 2 – the lower surface of the dielectric body). Sato further does not teach relative spacing (Applicant's "D") between Sato's plate-shaped dielectric body (4, Figure 2; column 4, lines 25-35) and Sato's plasma radiating surface (41; Figure 2).

Otsubo teaches a slot antenna (Figure 2) in a microwave plasma reactor (Figure 1) having a number of slots (5a) formed and distributed in the microwave radiating surface where a part of the number of slots can be closed (column 7, lines 3-15). Otsubo further teaches a standing wave (column 19, lines 31-37) microwave between his microwave radiating surface (5; Figure 13) and his plasma exciting surface (4; Figure 13 – the lower surface of the quartz plate) – "...the standing wave of the microwaves is generated between the slot plate 5 and the stage 7 ".

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Sato to optimize the thickness of the dielectric plate, and for Sato to use Otsubo's slot antenna, with Sato's radial line slot configuration, during standing wave microwave propagation. Motivation for Sato to optimize the thickness of the dielectric plate is for optimizing the space "between the slot antenna and the quartz window 4 through which the microwaves pass so that the microwaves emitted from the slot antenna have room to expand" (column 9, lines 6-30) as taught by Otsubo, further, motivation for Sato to use Otsubo's slot antenna, with Sato's radial line slot configuration, under standing wave microwave propagation is for "easy" plasma generation as taught by Otsubo (column 19, lines 35-40) and circular TE_1 microwave generation for uniform and high density plasmas as taught by Sato (column 9, lines 7-30) .

Response to Arguments

7. Applicant's arguments filed March 29, 2004 have been fully considered but they are not persuasive.

8. Applicant states that Sato does not teach forming a standing wave. The Examiner agrees: "Sato does not teach forming a standing wave microwave between his microwave radiating surface (41; Figure 2) and his plasma exciting surface (4; Figure 2 – the lower surface of the dielectric body)." As was asserted initially by the Examiner.

9. Applicant states that Otsubo does not teach "a standing wave of a microwave is formed between the microwave radiating surface of the antenna and a lower surface of a quartz plate by determining the distance there between based on the wavelength of the microwave, as defined by the claimed invention." However, it was asserted by the Examiner that:

"Otsubo further teaches a standing wave (column 19, lines 31-37) microwave between his microwave radiating surface (5; Figure 13) and his plasma exciting surface (4; Figure 13 – the lower surface of the quartz plate) – "...the standing wave of the microwaves is generated between the slot plate 5 and the stage 7 "." That Otsubo is silent with respect to the relative positions and/or thickness of Otsubo's microwave radiating surface (5; Figure 13) and his plasma exciting surface (4; Figure 13 – the lower surface of the quartz plate) based on the wavelength of the microwave is recognized. However, the Examiner believes that said relative positions and/or thickness of Otsubo's microwave radiating surface and Otsubo's plasma exciting surface that sustain Otsubo's standing wave is an optimizable quantity as taught by Otsubo: Motivation for Sato to optimize the thickness of the dielectric plate is for optimizing the space "between the slot antenna and the quartz window 4 through which the microwaves pass so that the microwaves emitted from the slot antenna have room to expand" (column 9, lines 6-30) as taught by Otsubo".

10. Applicant believes that Otsubo's apparatus does not produce a standing wave:

"

In other words, the standing wave is not generated between the slot plate 5 and the lower surface of the quartz plate 4. As a result, Otsubo fails to teach or...

"

In response, the Examiner cites Otsubo's teachings of column 19, lines 20-40:

"

In this case, if the microwaves are radiated into the processing chamber 6, the standing wave of the microwaves is generated between the slot plate 5 and the stage 7 and effect preventing of attenuation of the electric field intensity of the radiated microwaves, whereby the plasma can be

generated easily.

“

As a result, and because both Otsubo’s slot plate 5 and quartz plate 4 are elements between Otsubo’s slot plate 5 and the stage 7, Otsubo then identically teaches “the standing wave is not generated between the slot plate 5 and the lower surface of the quartz plate 4.”.

Applicant states:

“

It is submitted that the lower surface of the quartz plate 4 of Otsubo is neither comparable nor analogous to the plasma exciting surface of the present invention since Outsubo discloses a microwave radiating sudace of the slot plate 5.

“

The Examiner disagrees. Specifically, Otsubo’s quartz plate 4 is both directly comparable and analogous to Applicant’s plasma exciting surface:

“

As a result, a standing wave of the microwave region between the lower surface (microwave surface) of the radial line slot antenna 6 and a surface (microwave reflecting surface) formed by the reflecting ends of the microwave. After that, the microwave reflecting surface becomes a plasma exciting surface, and a stable plasma is excited on the plasma exciting surface.

“ Applicant’s specification (page 10, lines 11-24)

Otsubo’s plasma exciting surface (4; Figure 2 – the lower surface of the dielectric body) is shown by Otsubo to be a plasma delimiting surface defining Otsubo’s processing chamber (6; Figure 1). Further, as stated above, Otsubo teaches identical means (5, 5a, 4; Figures 1,2; column

7, lines 3-15; column 19, lines 31-37) to delimit propagation of Otsubo's standing waves as taught by Applicant's specification (page 19, lines 14-23).

11. Applicant's arguments with respect to newly submitted claims 16-26 are addressed in the above body of rejections.

Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (571) 272.1442. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official fax phone number for the 1763 art unit is (703) 872-9306. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (571) 272-1700. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (571) 272-1439.

Rudy Zervigon
6/4/4